Española Basin Play

(USGS 2303)

General Characteristics

This hypothetical play covers a major part of the Española Basin north of the Hagan-Santa Fe Embayment (Fig. P-25). The southern boundary, which separates this play from the Hagan-Santa Fe Embayment Play, is the projected northern truncation edge of Cretaceous rocks. The eastern boundary is the uplifted Sangre de Cristo Mountains, the northern boundary is the narrowing and eastward offset of the rift system, and the western boundary is the volcanic Jemez Mountains. The entire play area is covered by late Tertiary synrift deposits, and little is known about the subsurface structure and stratigraphy (Fig. P-26).

Reservoirs: Potential reservoirs are Pennsylvanian carbonate rocks and possibly the Jurassic Entrada Sandstone along the southern margin, where it has not been removed by pre-Galisteo erosion. Reservoir thickness is estimated to be less than 100 feet.

Source rocks, timing and migration: Postulated source rocks would be marine shales within the cyclic Pennsylvanian system and, where preserved, the basal shale of the Todilto Limestone Member. Sparse data indicate the maturation levels in Pennsylvanian rocks and Tertiary rocks to be in the oil-generating window. The data on Tertiary rocks are from depths of 6,000-7,000 feet (Gautier et al., 1996).

Traps: The play is an oil play for structural traps.

Exploration status: Only about four exploration tests have been drilled in the Española Basin Play area. Two wells east of the city of Española, drilled in 1931 and 1961, bottomed in Pennsylvanian rocks at depths of about 1,700 and 2,730 feet, respectively. Minor oil shows were reported in both wells. These wells were probably drilled on an intermediate fault block adjacent to the Sangre de Cristo Mountains (Molenaar, 1987). No specific data has been provided on these wells.

Resource potential: In summary, the Española Basin Play is speculative and risky. Although oil shows have been reported, good source rocks and reservoirs have not been documented. Seismic data and additional well control are necessary to further evaluate the play.

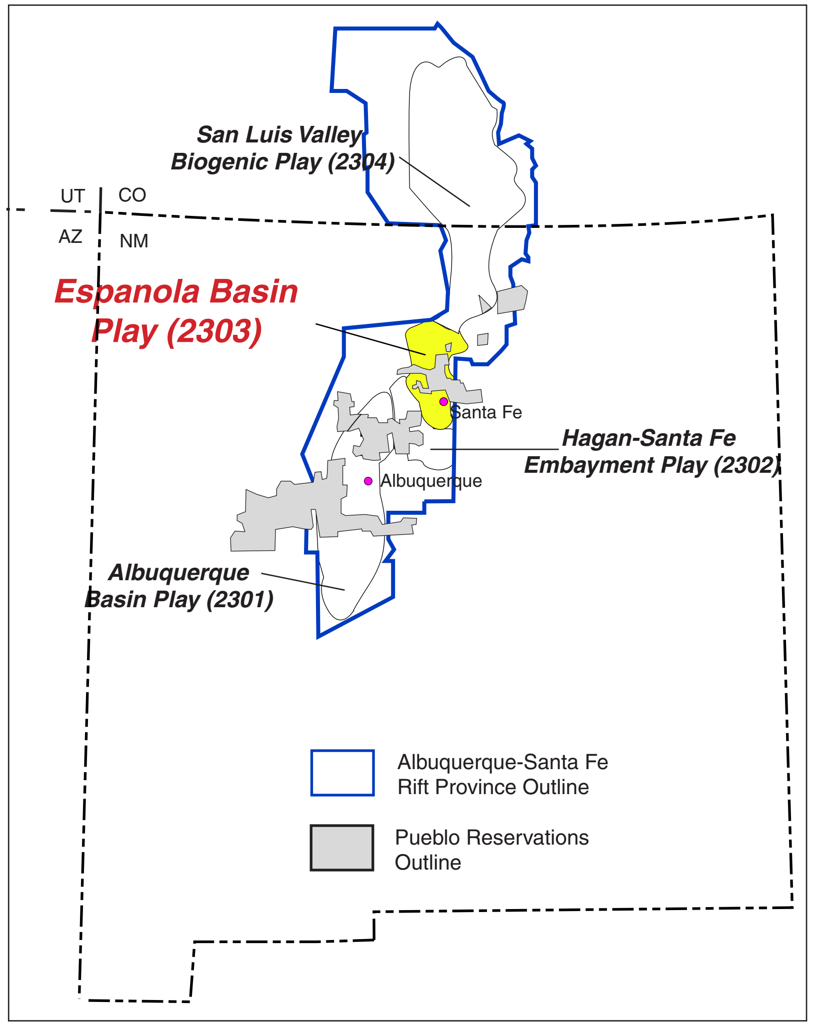

Figure P-25. Location of Espanola Basin Play (2303) with respect to the Pueblo Reservations (modified after Gautier et al., 1996).

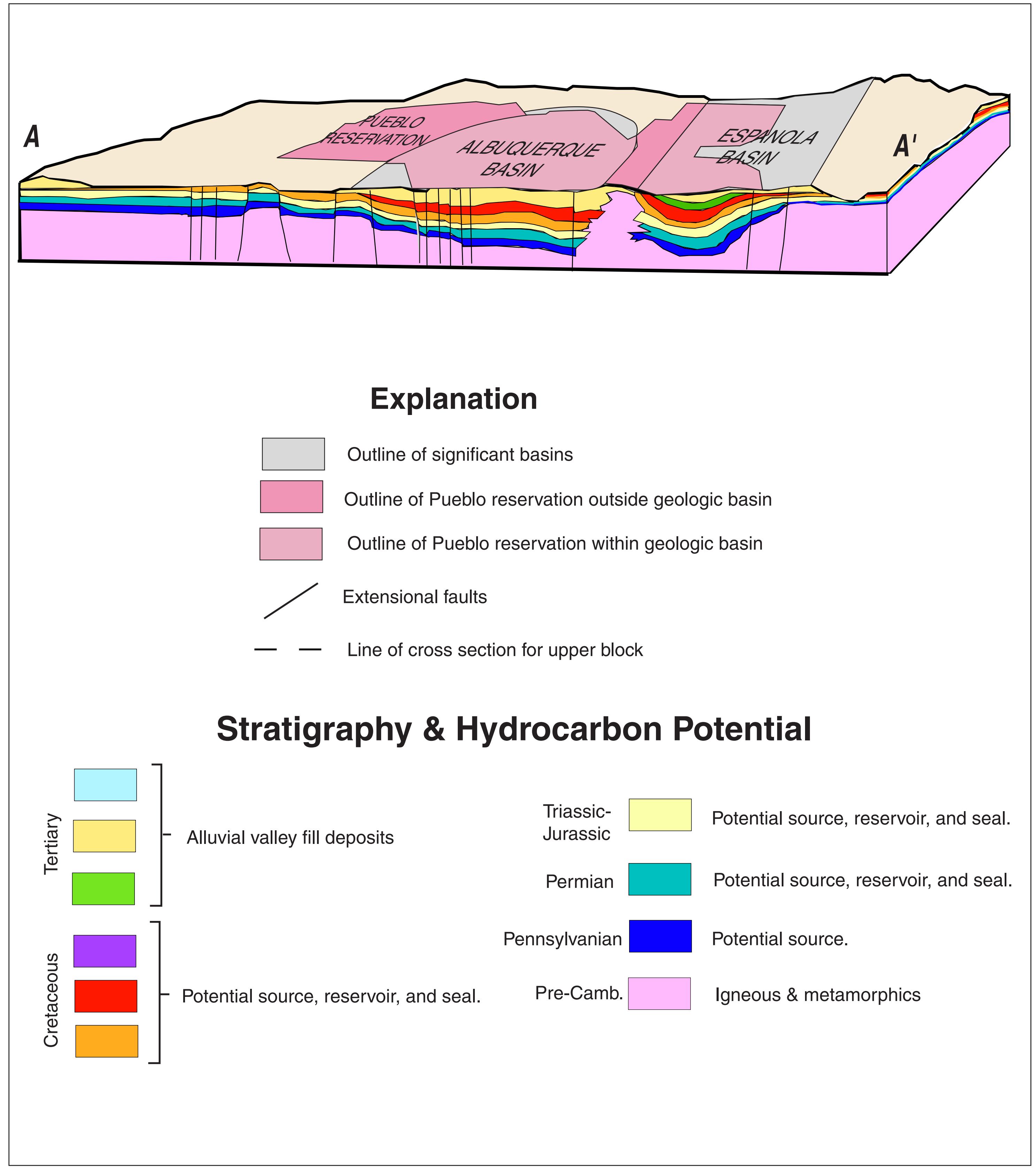

Figure P-26. Block diagram of the Espanola Basin (modified after Black, 1982).

San Luis Valley Biogenic Gas Play

(USGS 2304)

General Characteristics

This hypothetical play covers an elongate area about 70 miles long and 20 miles wide in the east-central part of the San Luis Valley (Fig. P-27), which is a rifted valley filled with continental Tertiary deposits (Fig. P-28). The boundaries are arbitrary, and the play is based on the many gas shows in shallow water wells in the area north and east of Alamosa, Colorado (Fig. P-29). Gas has been produced from about 35 of these wells and used by farmers for heating purposes for many years. Analytical data indicate that the gas is of biogenic origin. The reservoirs for gas in this play are sands or sandstones in lacustrine, clay-rich beds of Pliocene age. Whether or not a commercial accumulation of gas exists in this play is speculative. Certainly at such shallow depths, the reservoir pressure would be low.

Limited geoph ysical and well data indicate that a basement high or horst block underlies the play area (Fig. P-28). Depth to Precambrian Basement is as shallow as 6,000 feet. The deepest part of the greater San Luis Basin, which is bounded by the foothills of the San Juan Mountains on the west, and by the Sangre de Cristo Mountains on the east, is near the east margin. According to gravity calculations, the top of the Precambrian surface is at a depth of about 22,500 feet in the structurally low area northeast of Alamosa. A slightly greater depth was calculated for the area a few miles west of Taos, New Mexico.

In addition to the shallo w wells that were drilled for gas, or water wells that were converted to gas wells, about 23 wells were drilled in the greater San Luis Valley area (Fig. P-29). Three wells in the northern third of the San Luis Valley that penetrated the entire section found Tertiary on Precambrian. The other wells were still in Tertiary rocks at total depth. The hydrocarbon potential of this large area is very low.

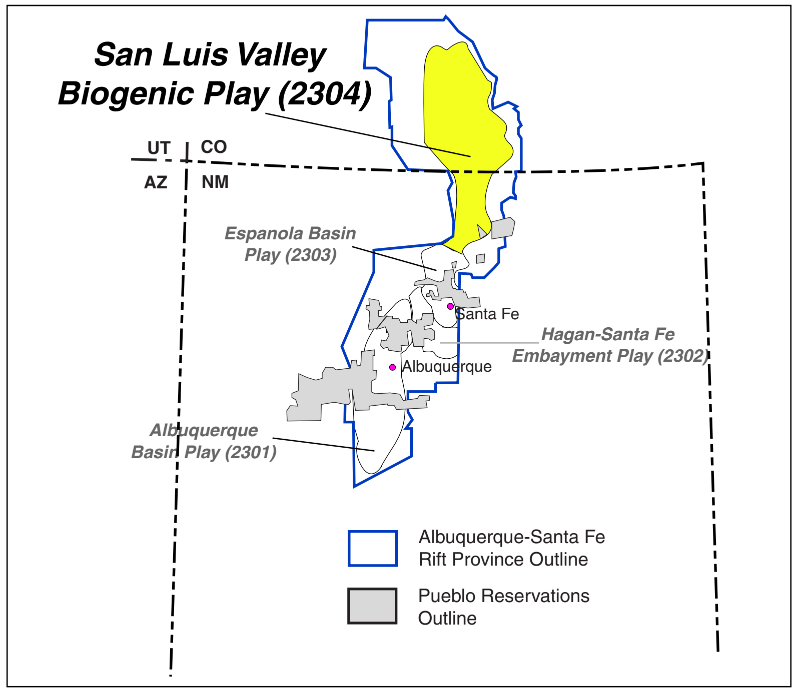

Figure P-27. Location of the San Luis Biogenic Play (2304) with respect to the Pueblo Indian Reservations (modified after Gautier et al., 1996).

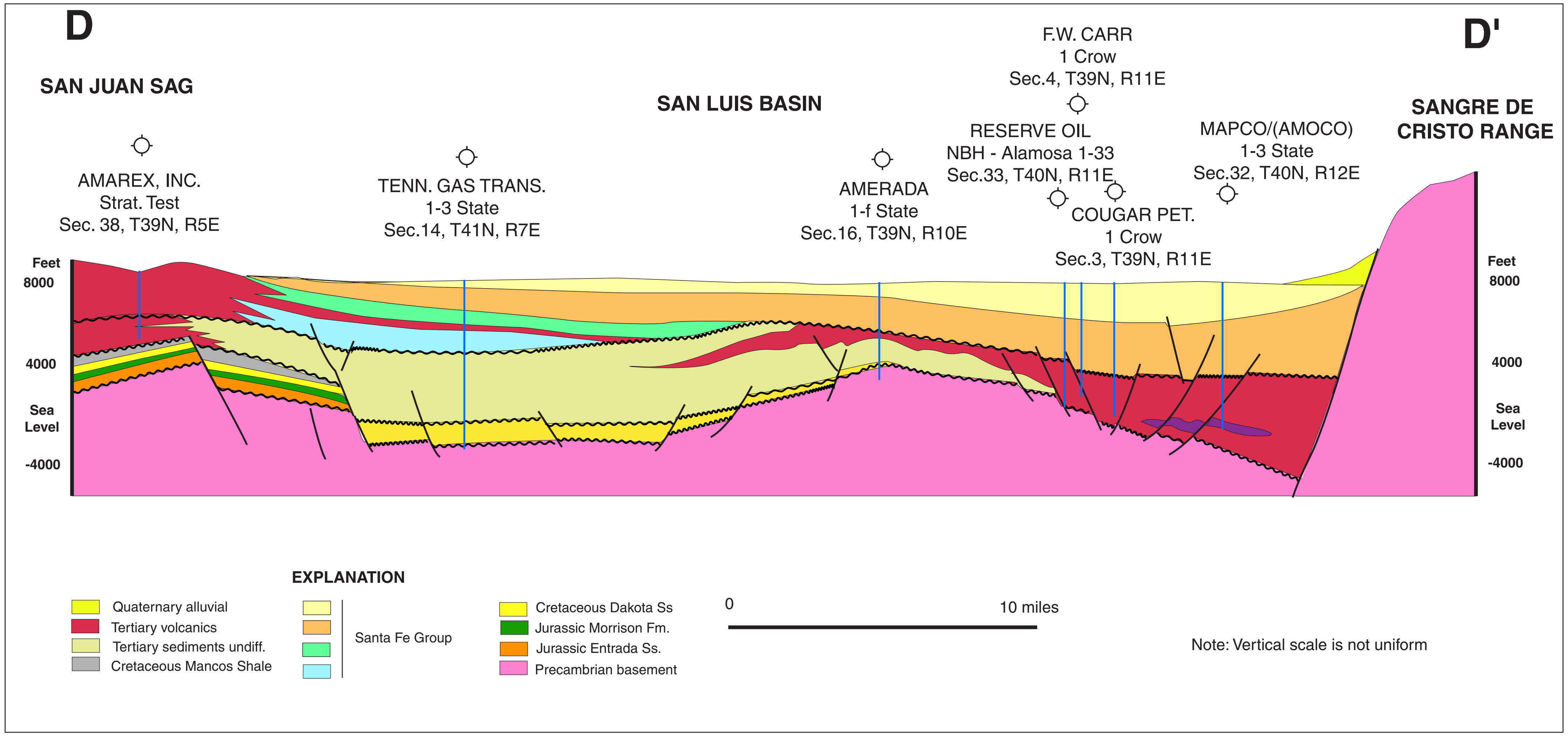

Figure P-28. Geologic cross-section across San Luis Basin. Vertical scale is a conversion of a time-depth scale from a seismic section. Therefore, the vertical scale is not uniform (Fig. P-7; cross-section 4) (modified after Gries, 1985).

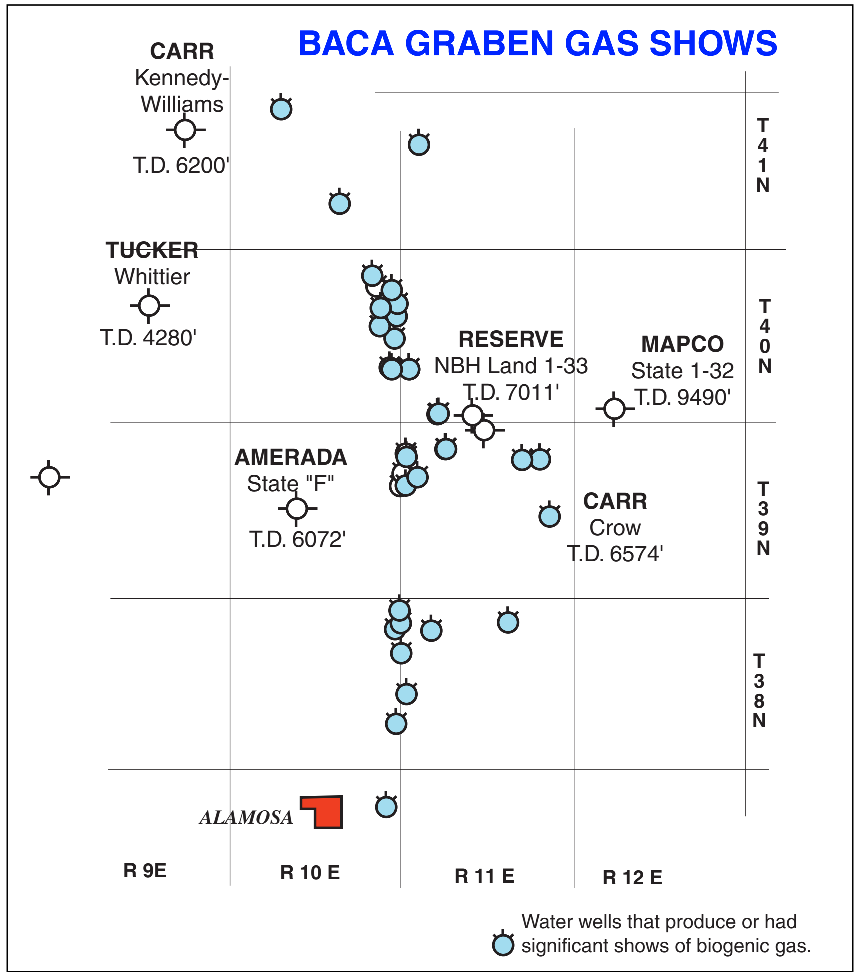

Figure P-29. Location of water wells that produce or had significant shows of biogenic gas within the Baca Graben of the San Luis Valley (modified after Black, 1982)

Raton Basin-Sierra Grande Uplift Province

The Raton Basin is an elongate, asymmetric basin in southeastern Colorado and northeastern New Mexico, analogous to other Rocky Mountain structural-stratigraphic basins associated with the Rocky Mountain Laramide Orogenic Belt. It is bounded on the west by the Sangre de Cristo Uplift, on the north by the Wet Mountains and the Apishipa Arch, and on the southeast by the Sierra Grande Uplift. The basin is approximately 175 miles long and up to 65 miles wide. It encompasses approximately 18,800 square miles (Fig. P-30) and sedimentary rocks within the basin may be 15,000-20,000 feet thick in the deepest part (Fig. P-31). The western flank of the basin dips steeply to the east and has been affected by substantial transcurrent and thrust faulting. In the Miocene, the basin was intruded by the Spanish Peaks igneous complex, which was accompanied by exten sive fracturing and intrusion of numerous dikes and sills. Intrusion of the Spanish Peaks Complex does not appear to have significantly elevated the general geothermal level of the entire basin.

Post-Precambrian stratigraph y in the Raton Basin is typical of the southern Rocky Mountains. A thin carbonate succession (Devon ian/Mississippian) overlies the Precambrian Basement (Fig. P-32). Overlying this sequence are 5,000-10,000 feet of terrigenous Per mian-Pennsylvanian strata, largely sandstones and redbeds. Triassic redbeds (approximately 1,000 feet thick) overlie about 500 feet of terrigenous Jurassic sediments. The Cretaceous section includes 200 feet of the basal sequence of clastic Purgatoire/Dakota, followed by 1,000-2,000 feet of marine chalks, marls, and organic-rich shales of the Benton and Niobrara Groups. This sequence is overlain by ap proximately 2,500 feet of Pierre Shale. The marginal marine, partly deltaic Trinidad Sandstone overlies the Pierre, and is in turn overlain by the coal-bearing Vermejo Formation. The Upper Cretaceous/Pa leocene coal-bearing Raton Formation overlies the Vermejo. Tertiary sediments of the Poison Canyon Formation overlying these strata are highly variable, and represent continental terrigenous sedimentation during the end of the Laramide Orogeny. Perhaps 10,000 feet of Ter tiary sediments were originally deposited, but erosion has removed much of the sediment, especially around the basin margins. A gener alized stratigraphic section showing the hydrocarbon-bearing strata is shown in Figure P-31.

In the Colorado portion of the Raton Basin, g as wells have pro duced measurable quantities from Permian, Upper Triassic, and Cre taceous strata in Las Animas County, and from Cretaceous age rocks in Huerfano County (Fig. P-33). Approximately 4,000 bbl oil were produced from the Codell Formation (Cretaceous) at the Gardner Field (now plugged and abandoned) in Huerfano County. The Gar cia Field (Fig. P-34), now abandoned, in Las Animas County, Colo rado, produced 1.5 BCFG from the Cretaceous Pierre Formation and Apishipa Member of the Niobrara Formation between 1896 and 1943. Natural gas was produced from the Dakota and Morrison For mations in the now-abandoned Wagon Mound Field in Mora County, New Mexico (Fig. P-35).

Carbon dioxide is produced from the Sheep Mountain Field and Dike Mountain Fields, Huerfano County, Colorado. Drilling began in the early 1970's, when the target was oil and (or) gas. Production of CO_2 is from the Cretaceous Dakota and Jurassic Entrada Formations at depths between 3,500 and 6,000 feet. The field has produced ap proximately 481 BCF of CO_2. The Bravo Dome [Bueyeros Field] (Fig. P-36), located in parts of Harding, Union, and Quay Counties, New Mexico, also produces CO_2, in part from the Permian Glorieta and Yeso Formations, and has produced [through 1990] 118 BCF of CO_2. This field is estimated to contain more than 16 TCF of CO_2 re serves; approximately one-half is estimated to be recoverable with existing technology (Keighin, 1995).

No commercial oil or g as fields are now active in the basin area, although the coal-bearing Raton and Vermejo Formations yield sig nificant quantities of methane. Two hypothetical conventional gas plays are defined. These are the Upper Cretaceous-Lower Tertiary Play (4101), and Jurassic-Lower Cretaceous Play (4102). An uncon ventional coalbed gas play, the Southern Raton Basin Play (4152) is also relevant for gas production in or near the Pueblo Indian Reserva tions (Fig. P-30).

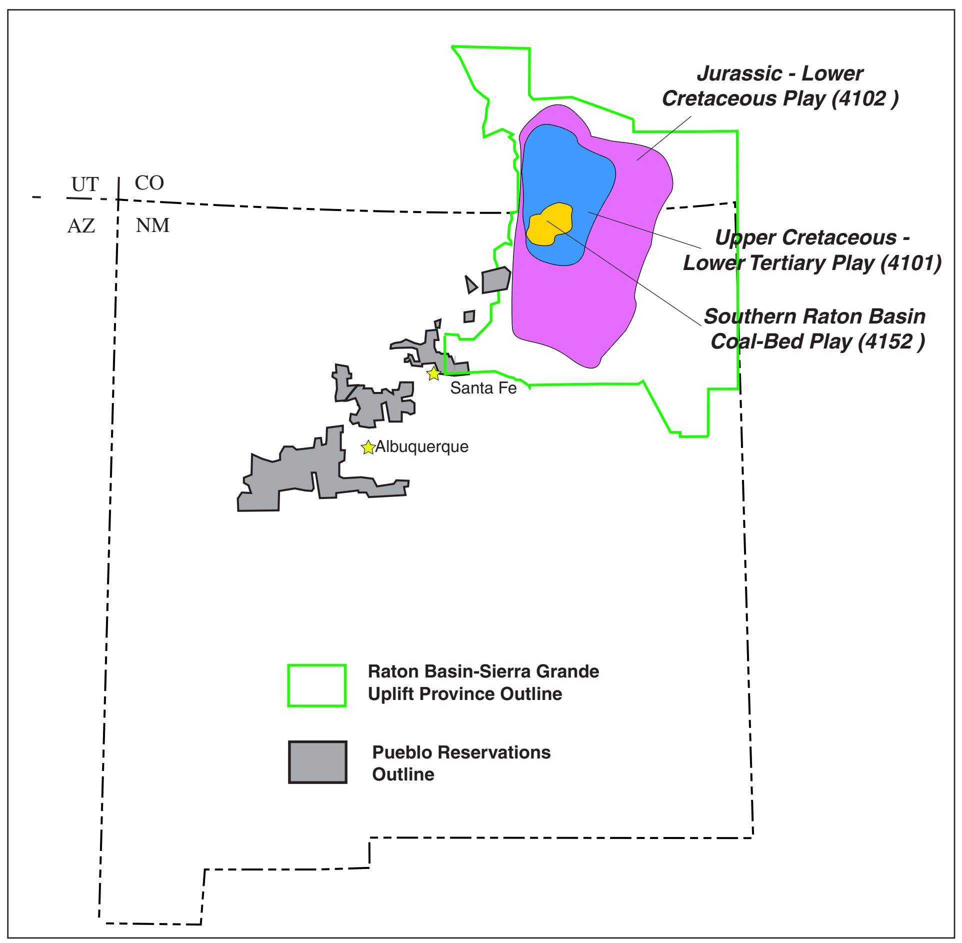

Figure P-30. Outline of Pueblo Reservations with respect to the Raton Basin-Sierra Grande Uplift Province. The Upper Cretaceous-Lower Tertiary Play (4101), Jurassic-Upper Cretaceous Play (4102) and Southern Raton Basin Coal-Bed Play (4152) are depicted (modified after Gautier et al., 1996).

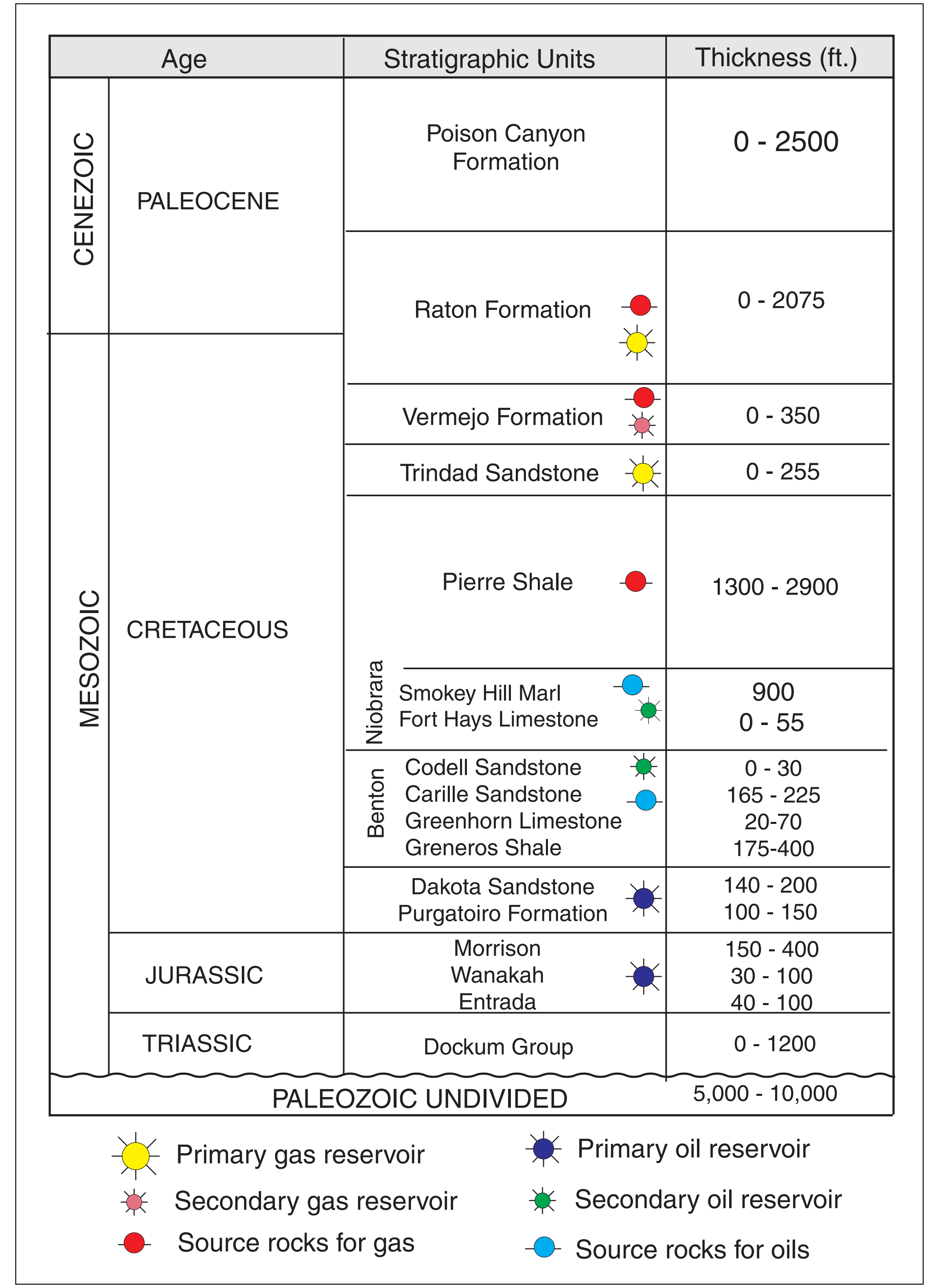

Figure P-31. Stratigraphic section depicting bedding relationships within the Raton Basin-Sierra Grande Uplift Geologic Province (modified after Gautier et al., 1996).

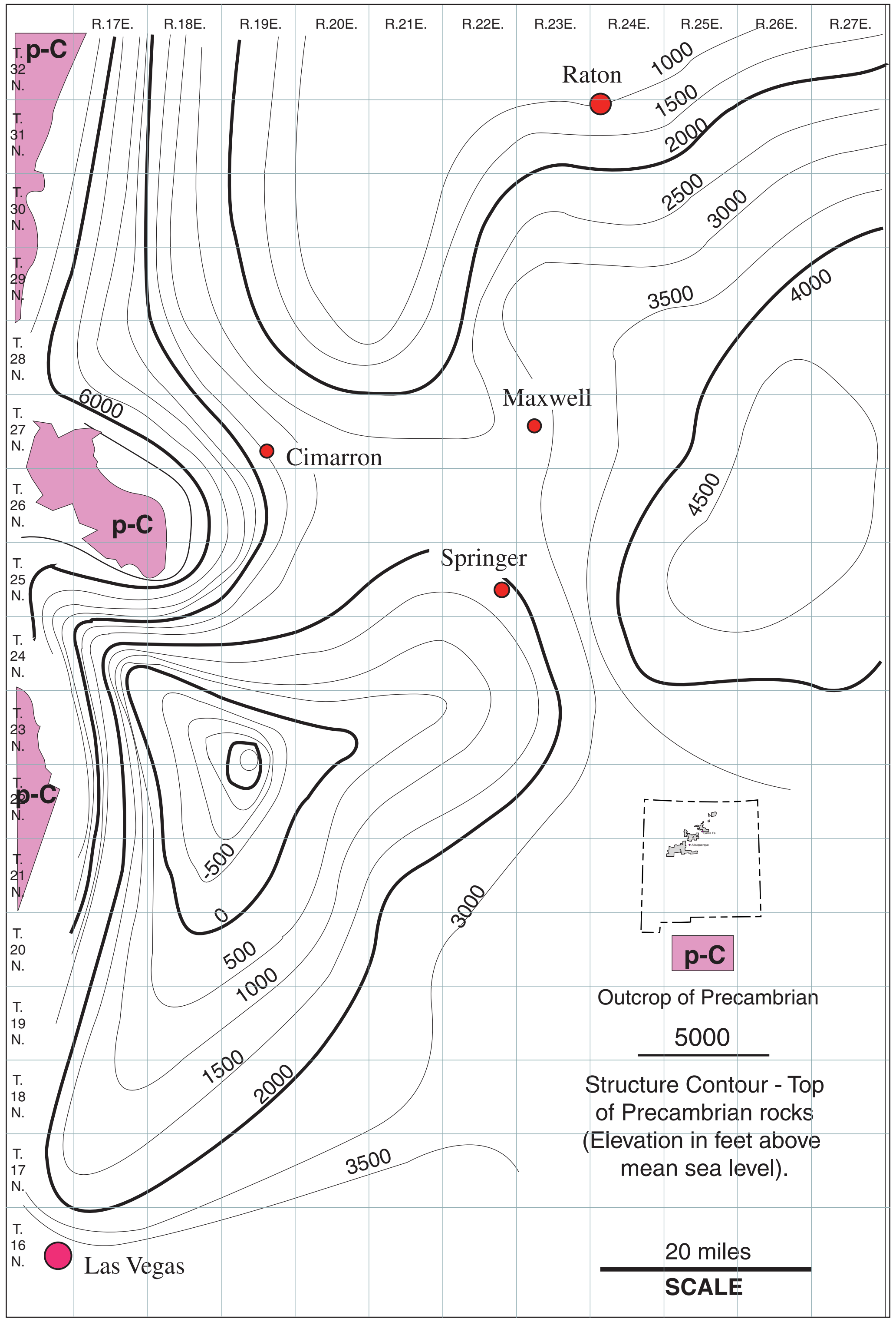

Figure P-32. Structure-contour map of top of Precambrian basement rocks in Raton Basin, New Mexico (modified after Woodward and Snyder, 1976).

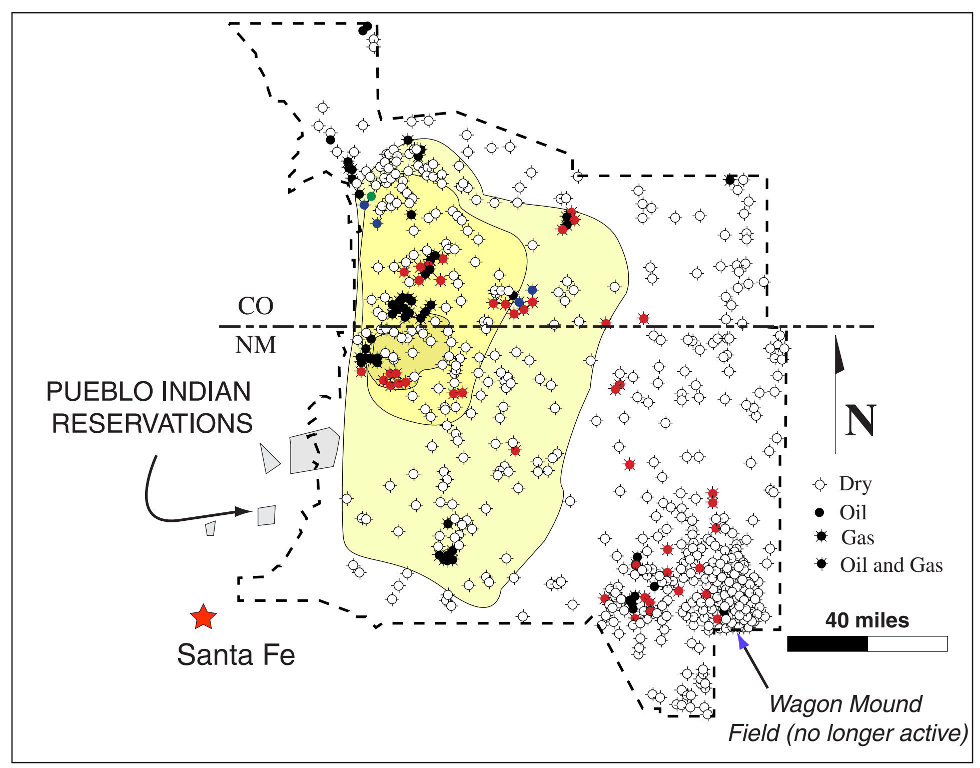

Figure P-33. Outline of Raton Basin-Sierra Grande Uplift Geologic Province with exploration wells from 1900-1993 illustrated. Also highlighted is the outline of the hydrocarbon plays within the region (modified after Gautier et al., 1996).

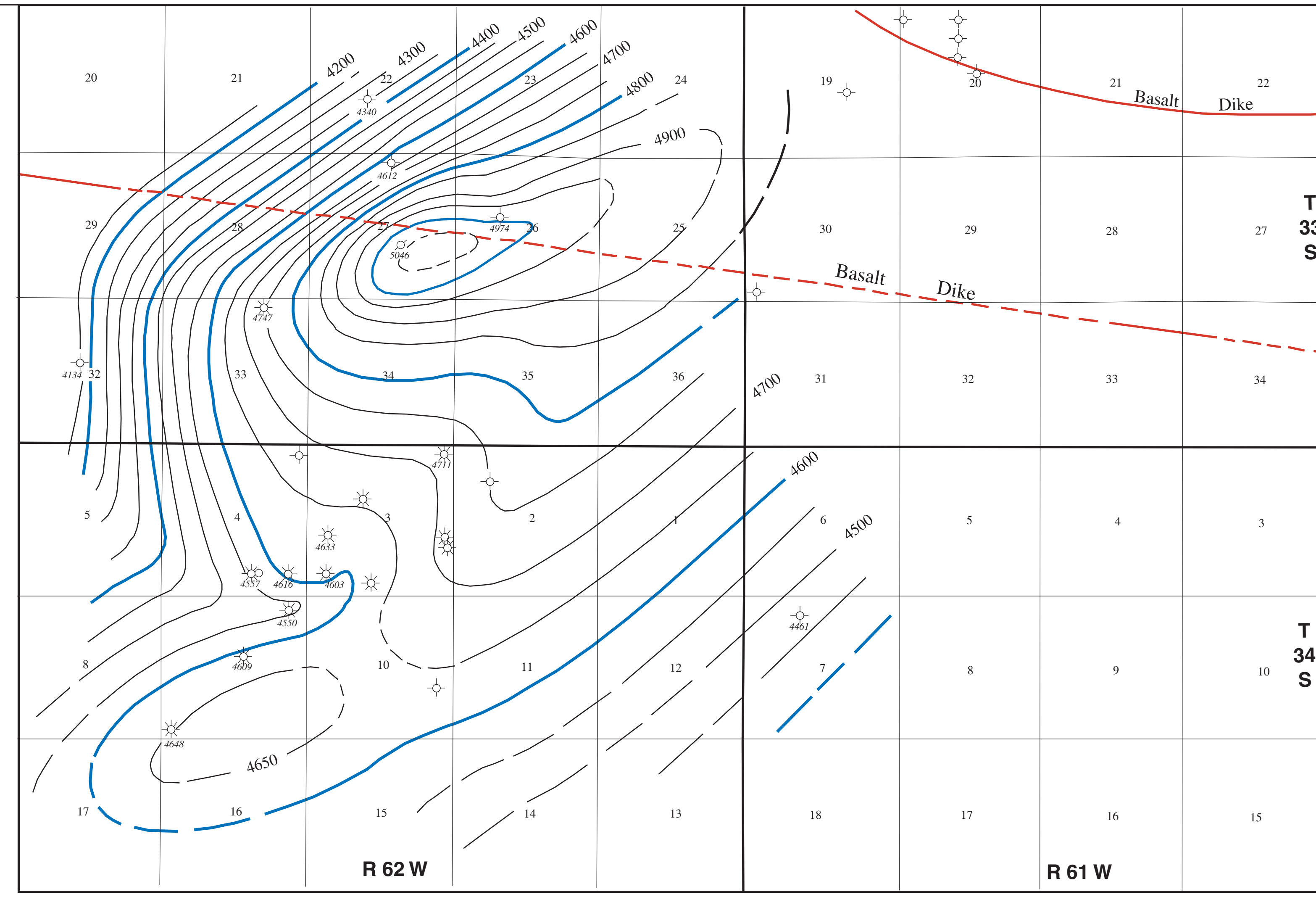

Figure P-34. Structure map of Garcia Field. Datum is the base of the Timpas limestone; contours are in feet (modified after Clair and Bradish, 1956).

Analog Field Within Raton Basin near Pueblo Reservations

Garcia Field

(Figure P-34)

- Location of Discovery Well: T34S, R62W
- Producing Formation: Codell Fm; Greenhorn Lms; Dakota Ss
- Type of Trap: Stratigraphic; anticline
- Initial Production: 1.5 MCFD
- Cumulative Production: NA
- Gas Characteristics: 26.6 gravity API
- Type of Drive: Low pressure
- Average Net Pay: variable
- Porosity: NR
- Permeability: NR

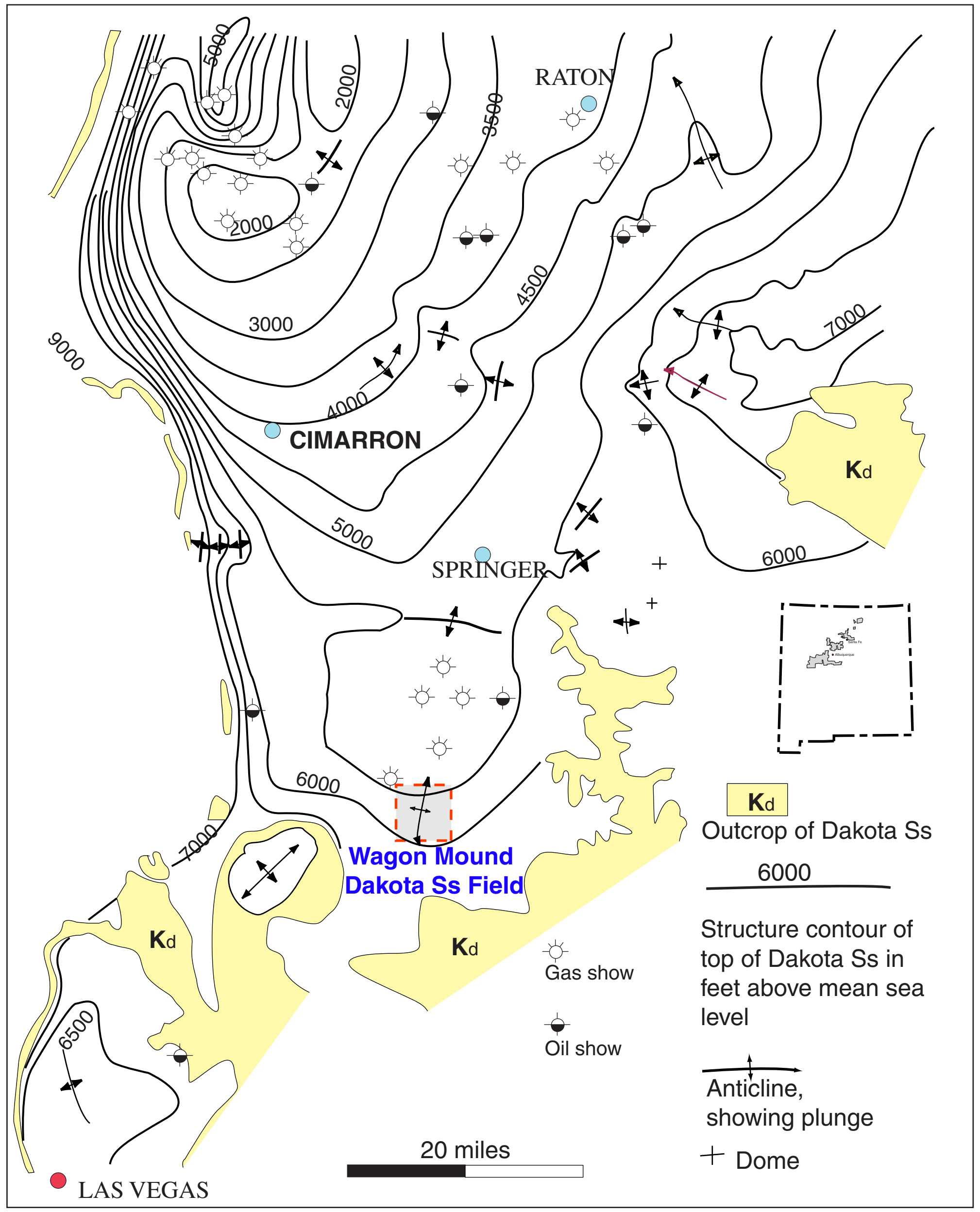

Figure P-35. Structure-contour map of top of Dakota Formation (Cretaceous) in Raton Basin, New Mexico (modified after Northrop et al., 1946; Bachman, 1953; Simms, 1965; Pilmore, 1969; Speer, 1976; and , 1974).

Wagon Mound Field

(Fig. P-35)

Location of Discovery Well:	T21N, R21E, sec14, Mor a County, NM
Producing Formation:	Cretaceous Dak ota Ss & Jurassic Morr ison Fm
Type of Trap:	Shale (Gr aneros Shale); Stratigraphic
Initial Production:	300-500 thousand cubic f eet per day
Cumulative Production:	NR
Gas Characteristics:	NR
Type of Drive:	Gas pressure (lo w)
Average Net Pay:	110 f eet
Porosity:	15%
Permeability:	~2 darcies

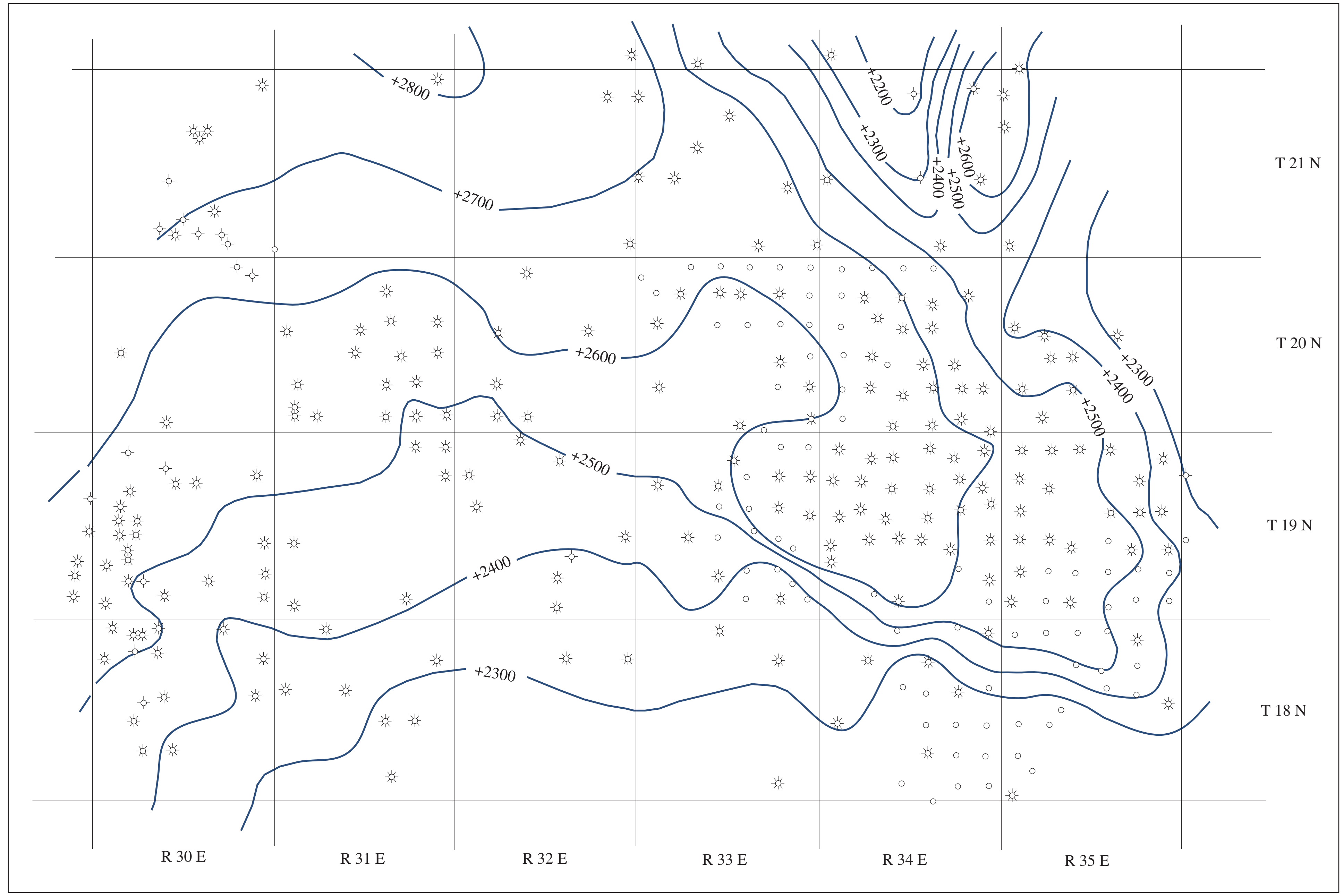

Figure P-36. Structure map of the Bravo Dome Carbon Dioxide Area Field showing the base of the Cimarron Anhydrite. Contour lines are in feet (modified after Johnson, 1983).

Bravo Dome Field

(Figure P-36)

Location of Discovery Well:	s w nw sec 32, T20N, R31E (No.1 Bueyeros)
Producing Formation:	Santa Rosa ss (T riassic); Sangre De Cristo Fm
Type of Trap:	Str atigraphic
Initial Production:	1,500 MCFD
Cumulative Production:	5.3 to 9.8 TCF (estimated)
Gas Characteristics:	98.6 to 99.8% CO_2
Type of Drive:	Gas Expansion
Average Net Pay:	100 f eet
Porosity:	20%
Permeability:	42 millidar cies